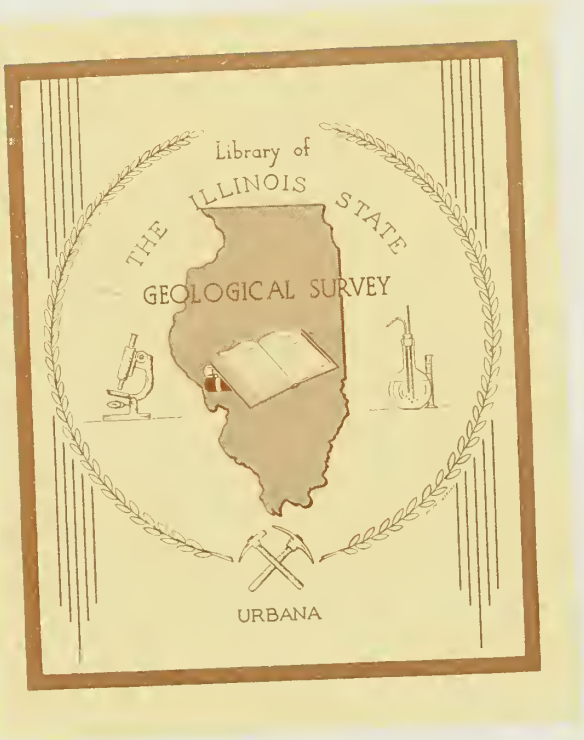

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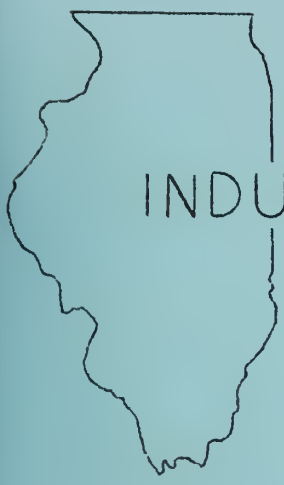

INDUSTRIAL MINERALS NOTES No. 27

HIGH-PURITY LIMESTONES IN ILLINOIS

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A B S T R A C T

High-purity limestones of various thicknesses occur in western, southwestern, and extreme southern Illinois. The limestone is now being quarried at a number of places. Occurrences of limestone of high purity (more than 95 percent calcium carbonate and more than 97 percent total calcium and magnesium carbonate) are reported by districts, and chemical analyses are given.

INTRODUCTION

High-purity limestone resources of Illinois, including both developed and undeveloped deposits, are discussed in this report. No attempt is made to describe individual deposits; such information as is at hand may be had upon request or can be found in the Illinois State Geological Survey publications listed at the end of this report.

High-purity limestones are arbitrarily defined herein as those containing more than 95 percent calcium carbonate and more than 97 percent total calcium and magnesium carbonates. They might also be called high-calcium limestones.

The resources are discussed according to geographic districts; the locations of towns mentioned are shown in figures 1, 2, and 3. Table 1 gives chemical analyses, arranged by districts. The analyses are intended to give an idea of the composition of the high-purity limestones available. They are too few to give a complete picture of any deposit or the variations therein, and, therefore, a deposit should not be rejected or accepted on the basis of the data in the table without further sampling and testing, especially if very small amounts or small tolerances of certain minor components in the limestones are critical for the projected use.

Most of the analyses in the table were made by the Analytical Division, Geochemical Group, of the Illinois Geological Survey. With some exceptions, each of the samples analyzed consisted of a series of rock pieces taken at closely spaced vertical intervals from the bed or beds sampled. The samples whose analyses are given came from natural outcrops, railroad cuts, idle quarries, idle parts of quarries, or working quarry faces.

To avoid confusion for those wishing to refer to the geologic reports mentioned herein, the names of the rock units employed are those used in the reports. Recent work (Lineback, 1966) has led to changes in some of the names. In such cases, the new names are indicated by a footnote.

ROCK ISLAND DISTRICT

A very fine-grained, white to gray, high-purity limestone, some of it brecciated, in beds up to 3½ feet thick has been and is being produced

Fig. 1 - Places in the Rock Island, western Illinois, Alton, and Dupo districts referred to in the text.

from quarries at Moline (fig. 1). The stone is the Wapsipinicon Limestone. Some of the stone produced earlier was sold to sugar refineries and carbide works (Krey and Lamar, 1925). The maximum thickness of the stone deposit varies but may reach 50 feet. Chemical analyses are given in table 1. The flat of the Rock River Valley in the vicinity of Milan may be underlain by Wapsipinicon Limestone in places (Savage and Udden, 1922).

WESTERN ILLINOIS DISTRICT

Burlington Limestone

The Burlington Limestone Formation crops out at many places in western Illinois, roughly from Oquawka almost to the junction of the Illinois and Mississippi Rivers at the tip of Calhoun County (fig. 1). Outcrops are most common in the bluffs and tributary valleys of the Mississippi River and along the Illinois River, roughly from Naples southward. Most of the Burlington Limestone is cherty, but at—or a few feet above—the base of the formation a chert-free bed of high-purity limestone, about 10 to 25 feet thick, occurs near Quincy and possibly elsewhere. The analyses from Marblehead and Quincy (table 1) are of the high-purity stone. It is generally coarsely crystalline; where the bed is finer grained the amount of magnesium carbonate generally increases.

The basal chert-free unit is mined underground from the Mississippi River bluff at and south of Quincy. It is probable that large-scale production of this stone will involve underground mining because the deposits are relatively thin and the overburden is likely to be heavy.

Other parts of the Burlington Formation contain beds of chert-free limestone, but these beds are not known to be as consistent in occurrence or as thick as the basal stratum of the Burlington described above.

The precise amount of chert in the cherty part of the Burlington Limestone has not been determined but may be as high as 10 percent by weight in places, though much less at others. It is possible that much or most of the chert could be removed by mineral beneficiation processes. An idea of the composition of the beneficiated limestone is given by samples R 100 and R 110 in table 1, which consist of only the limestone portion of cherty Burlington stone. There may be a possibility of producing high-calcium limestone through suitable processing.

A number of quarries are producing agricultural limestone and road rock from the Burlington Formation in western Illinois, but the production of high-purity limestone centers in the Quincy-Marblehead area in Adams County.

Publications relating to the Burlington Limestone in western Illinois include those by Krey and Lamar, 1925, p. 205-232; Lamar et al., 1956; Harvey, 1964; and Rubey, 1952.

Kimmswick Limestone

The Kimmswick Limestone crops out in the Mississippi River bluff and along tributary valleys west of Batchtown in Calhoun County (Rubey, 1952, p. 19-22, pls. 1 and 2), where it underlies an area about 6 miles long from north to south with a maximum width of about a mile (fig. 1). Part of the area underlain by the limestone is characterized by sink holes. The limestone is about 70 feet thick. Samples NF 455A, NF 455B, and NF 455C (table 1) represent virtually the entire limestone unit and indicate that it is high-purity limestone. The strata dip gently to the east in the northern part of the outcrop area but the dip increases to the south. There appear to be possibilities for open pit quarrying or subsurface mining. There are no railroads in Calhoun County, but the Mississippi River affords transportation.

The Kimmswick Limestone also crops out along several small valleys tributary to the Illinois River about 4 miles west of Grafton. Some of the limestone is believed to be high-purity limestone. Locally the strata in the area are tilted.

The Kimmswick Limestone is not being quarried in either of these outcrop areas.

ALTON DISTRICT

The St. Louis Limestone crops out in the Mississippi River bluffs and along tributary valleys at and near Alton (fig. 1). It is not uniformly of high purity, but it contains layers of this type of stone up to 25 feet thick. Eight analyses are given in table 1. Much of the limestone is fine grained and gray. As most deposits have a comparatively heavy overburden, large scale production of the high-purity limestone would involve selective quarrying or mining.

The present availability of the limestone in the Mississippi River bluffs vicinity is questionable because of the presence of houses, concrete roads, and other structures. In a limited area north of Alton, the high-purity beds may crop out or occur at relatively shallow depths, but eliminating the metropolitan Alton area for obvious reasons, no other areas are known where thick units of the high-purity stone crop out. However, the high-purity beds probably could be mined locally at depths of 100 feet or more northeast of the limits of the populous area of Alton.

Two quarries and a mine are producing limestone in the Alton area.

The limestone resources of the Alton area and Madison County, in which Alton is situated, were discussed in detail by Baxter (1965).

DUPO DISTRICT

East of Dupo (fig. 1), the Mississippi River bluffs, from Stolle southwestward for about 6 miles almost to the line of St. Clair County, are

composed of limestone of the St. Louis Formation. This formation also underlies the uplands of the county, east and southeast of the bluffs. Most of the St. Louis Limestone is not high-purity limestone, but it contains strata of high-purity limestone, not known to exceed 15 feet thick (table 1). Such strata are commonly finely crystalline. Recovery of limestone from these beds probably would require selective quarrying or subsurface mining.

Three quarries are operating in the district.

SOUTHWESTERN ILLINOIS DISTRICT

The Southwestern Illinois District (figure 2) includes Monroe County and small parts of adjacent St. Clair and Randolph Counties. Five rock units may contain high-purity limestone. In order of decreasing geologic age they are the Kimmswick, Salem, St. Louis, and Ste. Genevieve Limestones, and limestones of Chesterian age.

Kimmswick Limestone

The Kimmswick Limestone crops out only in a small area east of Valmeyer in the Mississippi River bluffs and tributary valleys where it is brought to the surface by an upfold of the bedrock strata. The limestone is a high-purity limestone, and is presently being produced from an underground mine. A representative analysis of the stone is given in table 1.

Salem Limestone

An area underlain by the Salem Limestone extends as a band one-half to one mile wide from the vicinity of Columbia to a point beyond Waterloo. The topography of the area is rolling and outcrops are not known to be abundant. The analyses in table 1 show that high-purity limestone occurs in the area.

The Salem Limestone also is exposed at intervals in the Mississippi River bluffs, roughly from Prairie du Rocher northward to a point east of the village of Fountain, a distance of about 25 miles. Outcrops also occur along many of the tributary valleys cutting back from the bluffs.

The Salem Formation has been divided into four members in this area, as indicated below (Baxter, 1960).

Member	Thickness	Character of stone
Rocher	10 to 60	Much high-purity
Chalfin	40	Relatively thin beds of high-purity stone
Fults	30	Mostly impure
Kidd*	50 to 90	Much high-purity

*Now called Harrodsburg Member of the Ullin Limestone.

Fig. 2 - Places in the southwestern Illinois district referred to in the text.

Two underground mines are producing high-purity stone from the Rocher Member near Prairie du Rocher, in which area the unit has its maximum thickness. It thins northwestward. Much of it is oolitic. Chemical analyses appear in table 1.

The Chalfin Member contains beds of high-purity limestone as much as 27 feet thick, but it is mostly silty limestone, locally cherty. Chemical analyses of high-purity limestone from the Chalfin Member are given in table 1.

The Fults Member consists of many thin units that vary in character and composition. It is believed to be an unpromising source of high-purity stone.

The Kidd* Member contains much high-purity limestone in the southern part of the outcrop area, which lies east of the village of Kidd. Analyses are shown in table 1.

In the bluffs of the Mississippi River, the Salem Formation is commonly overlain by the St. Louis Limestone, which is capped by a considerable thickness of brown, clayey silt. Therefore, subsurface mining of the Salem appears likely to be the favored way of winning it in the bluffs areas and possibly at more inland points.

St. Louis Limestone

The St. Louis Formation underlies much of the west half of Monroe County. It crops out in sink holes and along streams, and generally caps the Mississippi River bluffs. While not generally a high-purity limestone, it may contain layers of high purity. The thickness of these layers probably does not exceed 25 feet.

Ste. Genevieve Limestone

The Ste. Genevieve Limestone crops out in the bluffs of the Mississippi River for about 6 miles in northern Monroe County. It is also exposed in places along creeks in a belt one-half to two miles wide that extends roughly from New Hanover southeastward to Burksville. Other outcrops occur in a relatively small area in the Mississippi River bluffs about 2 miles south of Prairie du Rocher. Much of the formation is believed to be oolitic, and although it is not generally a high-purity limestone it does contain such strata. No special study has been made of the high-purity strata in the Ste. Genevieve, but it is thought likely that they may range roughly between 10 and 25 feet thick.

Chesterian Limestones

In and near the Mississippi River bluffs in Randolph and northwest Jackson County, and at more inland points, limestone formations of Chesterian

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*Now called Harrodsburg Member of the Ullin Limestone.

Fig. 3 - Places in the southern Illinois district referred to in the text.

age crop out in places. For the most part they are thin or impure or contain interbedded shale. However, a study of the limestone resources of the lower Kaskaskia Valley (Bradbury, 1963) records high-purity limestone as much as 29 feet thick occurring locally in that area (table 1). The limestone is a part of the Haney Formation. Some of it is oolitic and is known as the "Marigold oolite." High-calcium limestone in the Haney Formation may occur locally in deposits of such thickness and extent as to be of possible commercial interest. Other deposits of high-purity limestone may possibly exist south of the Kaskaskia Valley area.

Analyses of high-purity limestones occurring in other Chesterian formations appear in table 1. These are comparatively thin.

SOUTHERN ILLINOIS DISTRICT

The term "southern Illinois" is used to designate the area made up of the seven southernmost counties of the state and includes the Ozark Hills area (fig. 3). Exposed in the region are the following formations that contain high-purity limestone, listed from oldest to youngest in geologic age: Kimmswick, Backbone, Grand Tower, Salem*, St. Louis, and Ste. Genevieve Limestones. A report on the limestone resources of the district is available (Lamar, 1959), and the geology of Hardin and adjacent parts of Pope and Saline Counties has been described in detail (Baxter, Potter, and Doyle, 1963; Baxter and Desborough, 1965).

Kimmswick Limestone

The Kimmswick Limestone Formation crops out in only a small area about 1 mile south of Thebes in the bluff and shore of the Mississippi River and in adjacent railroad cuts. The formation is about 100 feet thick; roughly the upper 10 to 20 feet contains a small amount of chert, but below this is high-purity limestone that is medium to coarsely crystalline and white or light gray; locally, some of the stone has a pink color. Chemical analyses are given in table 1.

The outcrops are on an upfold in the bedrock, which trends somewhat south of east and slopes downward in that direction. The fold appears to be steepest on the south side; on the north side, the strata slope gently downward so that the piers of the railroad bridge across the Mississippi River at the south edge of Thebes rest on the upper part of the Kimmswick Limestone.

The Mississippi River bluffs are only a few hundred feet from the river itself and the intervening area is traversed by a road and railroad. Overburden on the limestone in the river bluffs is generally thick, and, although the possibility of open-pit quarrying exists, it is likely that continuing large-tonnage production would involve underground mining.

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*Now divided into Ullin and Salem Limestones.

Backbone Limestone

The Backbone Limestone is most widely exposed in the bluffs along Hutchins Creek, where it crops out at intervals from section 1 to section 25, T. 11 S., R. 3 W., a distance of about 4 miles. The outcrop area lies 2 to 2½ air line miles east of the flats of the Mississippi River and is northeast of the village of Wolf Lake. However, a ridge several hundred feet high intervenes between the outcrops along Hutchins Creek and the river flats and the distance between the two by existing roads is considerably greater than the air line distance.

The lower part of the Backbone Formation is high-purity limestone. It is between 20 and 40 feet thick, medium to finely crystalline, almost white, light gray, or brownish gray, and parts of it have numerous stylolitic partings. It could likely be won by subsurface mining, and possibly by open-pit mining in selected tracts. The upper part of the formation is siliceous and cherty. Sample NF 444 in table 1 is from the Hutchins Creek area.

The Backbone Limestone is also exposed in the bluffs of the Mississippi River near Rattlesnake Ferry east of Howardton, where some of it is of high purity (sample NF 536, table 1). Parts of the formation are cherty. It also crops out north of Grand Tower in the south end of the Backbone, which is a narrow ridge rising above the flats of the Mississippi Valley. No analysis of the limestone has been made, but 25 feet or more of high-purity stone may be present. The limestone dips steeply to the east and probably would need to be mined underground if large tonnage production is desired.

Grand Tower Limestone

The Grand Tower Limestone is exposed in the Devils Bake Oven, a hill of small area, north of Grand Tower and at the north end of the Backbone mentioned above. As much as 35 feet of high-purity limestone may be present, although no detailed analyses of the limestone have been made. The strata dip strongly to the east, and large scale production would probably involve subsurface mining. Another outcrop of Grand Tower Limestone occurs in the south end of Walker Hill east of Grand Tower. The area underlain by the Grand Tower Formation at this place is probably not large.

Another outcrop of Grand Tower Limestone occurs in a roadcut about 1½ miles west of Mountain Glen in Union County (fig. 3). Twenty-two feet of gray to light gray, crystalline, high-purity limestone (table 1) is exposed. The base of the limestone is covered and the total thickness of the stone may, therefore, be more than 22 feet. The limestone strata dip roughly 10 degrees a little north of east.

Warsaw-Salem* Limestone

The Warsaw-Salem* Limestone crops out in a roughly northwest-southeast belt of varying width, which extends from a point about 6 miles

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*Now divided into Ullin and Salem Limestones.

north and a little west of Jonesboro to the vicinity of Ullin (fig. 3). A steeply dipping outcrop also occurs in an abandoned quarry at the north end of Walker Hill near Grand Tower. The high-purity limestone in the Warsaw-Salem* is granular, medium to coarse grained, light to dark gray or slightly brownish, and occurs in comparatively thick strata. Much of the high-purity stone is relatively soft. Its thickness in the Warsaw-Salem* varies. Three hundred feet of high-purity stone was encountered in a diamond drill core near Mill Creek; thickness at other places is given in table 1.

Quarries at Ullin and near Mill Creek are producing limestone from these formations.

St. Louis Limestone

The St. Louis Limestone crops out at many places in Hardin and Union Counties. No data are available indicating that it contains high-purity limestone, but as the formation does contain such stone in southwestern Illinois it is possible that it may also do so in extreme southern Illinois. The thickness of any high-purity limestone present is not likely to exceed 25 feet, and its production would involve either selective quarrying or subsurface mining.

Ste. Genevieve Limestone

The principal outcrop areas of the Ste. Genevieve Limestone are in Union, Johnson, and Hardin Counties. Smaller outcrop areas occur in Pope and Massac Counties. The formation is not high-purity limestone throughout, but it contains as much as 50 feet of such stone in places. The Ste. Genevieve Limestone is characteristically an oolite. Some of the high-purity strata are almost white and relatively soft; others are light gray or light buff, dense, and hard. Selective quarrying or subsurface mining would probably be necessary to produce high-purity stone in large tonnages.

Operating quarries in the Ste. Genevieve Formation are located in Anna, Shetlerville, Whitehill, Mermet, and Cave in Rock.

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*Now divided into Ullin and Salem Limestones.

TABLE 1—ANALYSES OF HIGH-PURITY LIMESTONE

Sample number	Approximate location	Limestone	Thickness (ft)	Source of analysis	$CaCO_3$	$MgCO_3$	SiO_2	Al_2O_3	Fe_2O_3
			ROCK ISLAND DISTRICT						
	Moline	Wapsipinicon	-	b	98.04	0.44	1.46	0.66	
BU 16	Moline	Wapsipinicon	8	d	96.67	1.21	1.66	1.16	
NF 459	Moline	Wapsipinicon	39	a	95.26	4.31	0.37	0.18	0.39
			WESTERN ILLINOIS DISTRICT						
SL 26-30	Gladstone	Burlington	16	d	96.21	1.34	2.79	0.32	0.22
	Marblehead	Burlington	-	d	98.45	1.28	0.21	0.04	0.10
	Marblehead	Burlington	-	d	97.40	1.40	0.40	0.68	0.12
R 110	Eldred	Burlington	61	d	95.23	4.16	1.27	0.08	0.32
R 100	Pearl	Burlington	56	d	97.85	0.77	0.39	0.33	0.33
NF 564	Quincy	Burlington	24	a	98.44	1.94	0.42	0.42	0.13
R 29	Batchtown	Kimmswick	37	d	99.10	0.88	0.74	0.28	0.62
NF 455A	Batchtown	Kimmswick	18	d	98.96	0.54	0.90	0.14	0.09
NF 455B	Batchtown	Kimmswick	24	d	99.12	0.75	0.42	0.14	0.12
NF 455C	Batchtown	Kimmswick	21	d	98.90	0.86	0.52	0.11	0.15
			ALTON DISTRICT						
NF 168C	Alton	St. Louis	22	d	98.17	0.06	1.85	0.66	0.34
NF 168E	Alton	St. Louis	22	d	99.72	0.79	0.40	0.37	0.24
NF 169F	Alton	St. Louis	15	d	96.54	0.54	2.25	0.53	0.29
NF 171D	Alton	St. Louis	25	d	97.47	0.71	2.13	0.08	0.58
NF 171E	Alton	St. Louis	11	d	98.18	1.13	0.60	0.03	0.68
BS 62-5F	Alton	St. Louis	25	e	98.56	0.67	-	-	-
BS 62-5B	Alton	St. Louis	8	e	97.78	0.77	-	-	-
BS 62-7B	Alton	St. Louis	8	e	96.05	0.98	2.57	0.09	0.32
			DUPO DISTRICT						
NF 160G	Dupo	St. Louis	11	d	97.58	0.38	1.73	0.19	0.74
NF 162K	Dupo	St. Louis	14	d	97.31	1.30	0.63	0.26	0.44
NF 163L	Dupo	St. Louis	13	d	96.70	1.80	1.16	0.02	0.54
			SOUTHWESTERN ILLINOIS DISTRICT						
NF 581A	Reilly Lake	Glen Dean	13	g	95.31	1.69	2.06	0.77	0.48
SL 55	Roots	Haney	20	d	98.27	1.11	0.73	0.22	0.28
NF 582B	Marigold	Haney	13	g	97.05	1.04	1.38	0.88	0.40

TABLE 1—CONTINUED

Sample number	MgO	CaO	Na_2O	K_2O	MnO	P_2O_5	SO_3	Loss on ignition	Remarks
					ROCK ISLAND DISTRICT				
	0.21	54.90	-	-	-	-	-	-	
BU 16	0.58	54.18	-	-	-	-	-	43.38	
NF 459	2.06	53.38	0.09	0.00	-	-	-	43.72	
					WESTERN ILLINOIS DISTRICT				
SL 26-30	0.64	53.90	0.11	0.05	-	-	0.07	42.34	
	0.61	55.17	-	-	-	-	-	-	
	0.67	54.58	-	-	-	-	-	-	
R 110	1.99	53.35	0.01	0.16	-	-	-	43.52	S, 0.06. Chert not included in sample; Eldred quarry
R 100	0.37	54.83	-	-	-	-	-	43.50	Lower beds in Pearl quarry; chert not included in sample
NF 564	0.93	55.16	0.03	0.02	-	-	-	43.78	From limestone mine
R 29	0.42	55.52	-	-	-	-	0.10	-	
NF 455A	0.26	55.45	0.07	0.03	-	0.172	-	43.34	0-18 ft. above base of formation
NF 455B	0.36	55.54	0.10	0.02	-	0.097	-	43.67	25½-49½ ft. above base of formation
NF 455C	0.41	55.42	0.10	0.02	-	0.085	-	43.56	49½-70½ ft. above base of formation
					ALTON DISTRICT				
NF 168C	0.03	55.01	-	-	-	-	0.14	42.67	
NF 168E	0.38	55.88	-	-	0.013	0.011	0.15	43.45	
NF 169F	0.26	54.10	-	-	-	-	-	42.43	
NF 171D	0.34	54.62	-	-	-	-	-	-	
NF 171E	0.54	55.02	-	-	-	-	-	43.67	
BS 62-5F	0.32	55.23	-	-	-	-	-	-	
BS 62-5B	0.37	54.79	-	-	-	-	-	-	
BS 62-7B	0.47	53.81	-	-	-	-	-	-	
					DUPO DISTRICT				
NF 160G	0.18	54.68	-	-	-	-	-	42.79	
NF 162K	0.62	54.53	-	-	0.015	0.006	0.10	43.62	
NF 163L	0.86	54.19	-	-	-	-	-	43.27	
					SOUTHWESTERN ILLINOIS DISTRICT				
NF 581A	0.81	53.41	0.03	0.06	-	-	-	42.69	
SL 55	0.53	55.07	0.00	0.05	0.016	0.045	0.06	43.07	"Marigold oolite"; TiO_2, 0.00
NF 582B	0.50	54.38	0.03	0.06	-	-	-	43.07	"Marigold oolite"

TABLE 1—CONTINUED

Sample number	Approximate location	Limestone	Thickness (ft)	Source of analysis	$CaCO_3$	$MgCO_3$	SiO_2	Al_2O_3	Fe_2O_3
		SOUTHWESTERN ILLINOIS DISTRICT - Continued							
NF 575	Collins	Haney	25	g	96.21	1.75	1.86	0.71	0.39
NF 576D	Roots	Haney	29	g	98.43	1.00	0.72	0.41	0.21
NF 576C	Roots	Haney	12	g	96.15	1.61	1.56	0.67	0.37
NF 573C	Hecker	Fraileys	5	g	96.97	0.69	1.47	0.84	0.63
NF 573A	Hecker	Fraileys	5	g	96.53	1.25	1.69	0.56	0.51
NF 583C	Modoc	Paint Creek	4	g	96.48	1.21	2.07	0.78	0.33
NF 583A	Modoc	Paint Creek	5	g	95.90	1.11	2.54	0.93	0.33
NF 330A	Modoc	Ste. Genevieve	14	d	98.68	1.02	0.69	0.35	0.18
NF 331F	Modoc	St. Louis	16	d	97.26	1.11	0.96	1.54	0.06
NF 167A	Columbia	Salem	35	d	97.36	1.07	1.42	0.05	0.36
NF 167B	Columbia	Salem	12	d	96.97	0.98	1.91	0.12	0.30
NF 167C	Columbia	Salem	14	d	98.50	0.82	0.67	0.13	0.29
NF 332A	Prairie du Rocher	Salem	43	d	97.79	0.77	1.55	1.01	0.12
NF 331A	Prairie du Rocher	Salem	37	d	98.17	1.17	0.65	1.43	0.09
NF 331B	Prairie du Rocher	Salem	22	d	96.67	0.82	1.01	1.72	0.13
JB 6A	Valmeyer	Salem (Chalfin)	16	f	98.10	0.54	1.53	0.29	0.06
JB 6B	Valmeyer	Salem (Chalfin)	6½	f	97.55	0.94	1.20	0.41	0.13
JB 6C	Valmeyer	Salem (Rocher)	11½	f	97.53	0.71	1.96	0.32	0.07
JB 2G	Chalfin Bridge	Salem (Rocher)	20	f	97.47	1.07	1.50	0.50	0.07
JB 1D	Fults	Salem (Chalfin)	15	f	96.14	1.02	2.43	0.39	0.11
JB 1E	Fults	Salem (Rocher)	38	f	98.14	0.94	1.28	0.28	0.10
JB 7B	Kidd	Salem (Kidd)*	12½	f	98.60	1.05	0.70	0.36	0.16
JB 7C	Kidd	Salem (Kidd)*	27	f	97.53	1.69	1.03	0.35	0.16
JB 7D	Kidd	Salem	40½	f	96.96	1.63	1.69	0.28	0.11
†	Valmeyer	Kimmswick	-	†	97.00	2.50	0.11	0.20	0.15
		SOUTHERN ILLINOIS DISTRICT							
NF 174A	Anna	Ste. Genevieve	7½+	d	97.29	1.34	1.07	0.50	0.29
NF 175D	Whitehill	Ste. Genevieve	56	d	97.09	2.43	1.44	0.37	0.28
NF 177A	Shetlerville	Ste. Genevieve	16½	d	98.27	1.09	1.13	0.51	0.31
NF 177B	Shetlerville	Ste. Genevieve	22	d	99.58	0.23	0.59	0.32	0.26
NF 443	Mill Creek	Warsaw-Salem**	50	d	99.09	1.46	0.29	0.26	0.11
L 1	Kaolin	Salem	60	d	96.70	0.73	0.72	0.20	0.10
NF 451A	Ullin	Warsaw-Salem**	14	d	97.58	1.86	1.12	0.20	0.07
NF 451B	Ullin	Warsaw-Salem**	24½	h	96.31	2.49	1.71	0.18	0.08
NF 451C	Ullin	Warsaw-Salem**	41	h	97.23	1.74	1.19	0.33	0.09
NF 516	Kaolin	Salem	39	h	97.33	1.71	1.36	0.19	0.09

TABLE 1—CONTINUED

Sample number	MgO	CaO	Na_2O	K_2O	MnO	P_2O_5	SO_3	Loss on ignition	Remarks
					SOUTHWESTERN ILLINOIS DISTRICT - Continued				
NF 575	0.84	53.91	0.03	0.06	-	-	-	42.70	
NF 576D	0.48	55.16	0.03	0.04	-	-	-	43.42	
NF 576C	0.77	53.88	0.03	0.06	-	-	-	42.96	
NF 573C	0.33	54.34	0.03	0.05	-	-	-	42.77	
NF 573A	0.60	54.09	0.02	0.07	-	-	-	42.84	
NF 583C	0.58	54.06	0.02	0.07	-	-	-	42.66	
NF 583A	0.53	53.75	0.03	0.09	-	-	-	42.42	
NF 330A	0.49	55.30	-	-	-	-	0.06	43.47	
NF 331F	0.53	54.50	-	-	-	-	-	43.07	
NF 167A	0.51	54.56	-	-	-	-	-	43.26	
NF 167B	0.47	54.34	-	-	-	-	-	42.97	
NF 167C	0.39	55.20	-	-	0.007	0.025	0.09	43.67	
NF 332A	0.37	54.80	-	-	-	-	0.06	42.71	
NF 331A	0.56	55.01	-	-	0.002	0.010	0.10	43.03	
NF 331B	0.39	54.17	-	-	-	-	-	43.01	
JB 6A	0.26	54.92	-	-	-	-	-	43.00	Channel deposit
JB 6B	0.45	54.66	-	-	-	-	-	43.10	
JB 6C	0.34	54.65	-	-	-	-	-	42.77	
JB 2G	0.51	54.62	-	-	-	-	-	43.15	
JB 1D	0.49	53.87	-	-	-	-	-	42.58	
JB 1E	0.45	54.99	-	-	-	-	-	43.14	
JB 7B	0.50	55.25	-	-	-	-	-	43.58	
JB 7C	0.81	54.65	-	-	-	-	-	43.38	
JB 7D	0.78	54.31	-	-	-	-	-	43.13	
†	-	-	-	-	-	-	0.029	-	P, 0.03
					SOUTHERN ILLINOIS DISTRICT				
NF 174A	0.64	54.52	-	-	-	-	-	43.06	
NF 175D	1.16	54.41	-	-	-	-	0.22	43.09	
NF 177A	0.52	55.07	-	-	-	-	-	43.15	
NF 177B	0.11	55.80	-	-	0.008	0.009	0.15	43.42	
NF 443	0.70	55.53	0.07	0.02	0.005	0.046	0.15	43.23	
L 1	0.35	54.19	-	-	-	-	-	-	
NF 451A	0.89	54.68	0.00	0.05	0.002	0.045	0.11	43.14	TiO_2, 0.00
NF 451B	1.19	53.97	0.01	0.06	0.002	0.055	0.14	43.90	TiO_2, 0.00
NF 451C	0.83	54.48	0.02	0.02	-	-	-	43.19	
NF 516	0.82	54.54	0.03	0.02	0.008	0.046	0.03	43.18	SrO, 0.034

TABLE 1—CONCLUDED

Sample number	Approximate location	Limestone	Thickness (ft)	Source of analysis	$CaCO_3$	$MgCO_3$	SiO_2	Al_2O_3	Fe_2O_3
		SOUTHERN ILLINOIS DISTRICT - Continued							
NF 565A	Mill Creek	Warsaw-Salem**	100	h	98.83	0.86	0.42	0.31	0.09
NF 565B	Mill Creek	Warsaw-Salem**	100	h	98.99	1.25	0.36	0.29	0.09
NF 565C	Mill Creek	Warsaw-Salem**	100	h	95.71	4.35	0.58	0.17	0.09
NF 457	Mountain Glen	Grand Tower	22	h	97.56	1.63	1.09	0.28	0.11
NF 444	Wolf Lake	Backbone	40	d	95.98	3.78	0.68	0.30	0.10
NF 536	Howardton	Backbone	29	h	95.37	3.62	0.98	0.37	0.19
NF 450	Thebes	Kimmswick	26	d	99.71	0.71	0.16	0.20	0.09
NF 522A	Thebes	Kimmswick	13	h	99.60	0.61	0.15	0.20	0.09
NF 522B	Thebes	Kimmswick	14	h	99.53	0.84	0.14	0.20	0.09

* Now called the Harrodsburg Member of the Ullin Limestone.
† H. W. Scherzer, personal communication, 1966
a Geochemical Group, Illinois Geological Survey
b Krey and Lamar, 1925
d Lamar, 1957
e Baxter, 1965
f Baxter, 1960
g Bradbury, 1963
h Lamar, 1959
** Now divided into Ullin and Salem Limestones.

TABLE 1—CONCLUDED

Sample number	MgO	CaO	Na_2O	K_2O	MnO	P_2O_5	SO_3	Loss on ignition	Remarks
					SOUTHERN ILLINOIS DISTRICT - Continued				
NF 565A	0.41	55.38	0.02	0.02	0.005	0.025	0.08	43.66	Diamond drill core, 178-278 feet deep
NF 565B	0.60	55.47	0.03	0.02	0.004	0.036	0.06	43.68	Diamond drill core, 278-378 feet deep
NF 565C	2.08	53.63	0.02	0.02	0.005	0.041	0.07	43.79	Diamond drill core, 378-478 feet deep
NF 457	0.78	54.76	0.02	0.03	0.024	0.017	0.09	43.32	-
NF 444	1.81	53.77	0.09	0.04	0.030	0.009	0.04	43.60	-
NF 536	1.73	53.44	0.02	0.03	-	-	-	43.46	SrO, 0.014
NF 450	0.34	55.86	0.06	0.01	0.038	0.034	0.09	43.44	TiO_2, 0.00
NF 522A	0.29	55.81	0.01	0.01	0.036	0.087	0.02	43.61	SrO, 0.015
NF 522B	0.40	55.77	0.01	0.01	0.048	0.094	0.05	43.73	SrO, 0.015

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* Out of print